ECONOMIC ANALYSIS OF ARMY ENLISTMENTS: POLICY IMPLICATIONS

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Significant improvements in the measurement of variables and promising preliminary findings at the occupational level highlight the two complementary studies of military enlistments documented in this report. In both studies regression analysis was used to estimate time-series cross-section (TSCS) models for NPS male 1-3A HSDG's and 3b HSDG's. Independent variables include economic and demographic factors as well as recruiters and measures of policy changes.

In the first study, models for each Service were estimated using annual Navy Recruiting District level data for the period beginning FY 1976 and updated through FY 1983. The relative military pay variable was constructed with 1980 Census microdata on the civilian earnings of youth (rather than youth and adults) and aged with 1976-83 youth-earnings data from annual Current Population Surveys (CPS) (published in Employment and Earnings). This new variable eliminated (relative to an earlier study) a downward bias of approximately 25% in estimates of the effects of pay. For unemployment a 50% bias was

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eliminated by the use of more accurate measures constructed with monthly county-level from the Bureau of Labor Statistics (BLS), aggregated to the recruiting district level The population variable was refined by using individual data from the 1980 Census and annual data from the CPS. The study not only yields improved estimates of the effects these supply factors, but provides new evidence concerning the effects of the Army Col Fund. The results provide accurate forecasts of enlistments and useful analysis of th cost-effectiveness of policies.

The second study explores the effects of bonuses on Army enlistments. TSCS model for each of ten DOD one-digit occupational codes were estimated using regression analy with annual district-level data for FY 1976-82. Variables include those from the prev study as well as measures for the level and coverage of enlistment bonus programs. Th findings indicate strong channeling effects of bonuses. However, the results, while promising, are preliminary in nature. More research is needed before the findings cou be useful for conducting policy analysis of specific bonus programs.

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PART I

A TIME-SERIES, CROSS-SECTION MODEL OF ENLISTMENT SUPPLY IN FY 1976-1983

CHAPTER I

INTRODUCTION

This two-part paper documents two complementary studies of Army enlistments. Part I reports the updating and further development of ERL's basic time-series, cross-section (TSCS) model, which analyzes the supply of non-prior service, male, upper mental category enlistments. Part II describes an extension of the TSCS analysis which focuses on enlistments at the occupational level, and makes an exploratory attempt to measure the effects of bonuses among occupations.

The TSCS model described in Part I was estimated in 1983 with annual Navy Recruiting District (NRD) level data for the period FY 1976-82. Reference no. 2 contains a complete bibliography of work done through 1983. The current study updates the data base to include FY 1983 observations, develops better measures of key variables, i.e., civilian pay, unemployment, and population; and re-estimates the model with data for the longer period FY 1976-83.

A. Data Refinements[1]

In the past, to construct measures of civilian pay, we used data from the 1970 Census to obtain cross section observations for 1970. (See reference no. 2.) These were aged with annual data from the Current Population Surveys (CPS) to yield data for FY 1976-82. For the current work, we use similar aging procedures. However, the baseline cross section NRD-level observations are derived from individual and county-level data recently collected in the 1980 Census.

In earlier work, unemployment in each NRD was measured using readily available data from the Bureau of Labor Statistics (BLS) for the major "SMSA" of each NRD. Since the NRD's are much larger than the SMSA's which stood in for them, the procedure, although convenient, introduced

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1 For details on the construction of variables, see Appendix A.

some measurement error. In this study we use an annual measure for each NRD, based on the aggregation of monthly county-level data from BLS. Although this data development requires more computer processing than the earlier procedure, it results in more reliable measures of unemployment.[2]

Previously our population measure included all 17-21 year-old males in a NRD, both civilian and military. Since the research focuses on the analysis of high school diploma graduate (HSDG) enlistments, the <u>total</u> male youth population variable introduces some measurement error. Here, we use individual data from the 1980 Census (and annual CPS's) to construct a more refined population measure — the number of 17-21 year-old <u>civilian</u> male HSDG's and high school seniors (HSSR's).

B. <u>Estimation Procedures</u>

HSDG enlistment models are estimated for 1-3A's and 3B's with annual data on net contracts for the period FY 1976-1983. Models are estimated using the ordinary least squares technique (OLS).

C. <u>The Report</u>

The main body of Part I of this paper reports the final version of the enlistment supply model selected for policy analysis and forecasting, and the regression output it yields. Chapter II specifies the econometric model. Chapter III reports estimates of the model, describes the forecasting test used, calculates the marginal cost of generating high quality contracts using alternative policies, and presents conclusions. Appendix A discusses the data used to estimate the model.

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2 Aggregation of BLS data to NRD's was carried out by the Navy Recruiting Command, Code 22.

CHAPTER II

AN ECONOMETRIC MODEL OF ENLISTMENT SUPPLY

We use regression analyses to estimate the effects of supply factors on the number of contracts signed in the 41 Navy Recruiting Districts by non-prior-service male, high school diploma graduates. Regression models are estimated for each Service with annual data for FY 1976T-83. Separate models are estimated for mental group 1-3A HSDG's and mental group 3B HSDG's.

A. Specification of the Model

A labor supply framework is used to specify enlistment equations. Enlistment is viewed as an employment decision that is heavily influenced by economic considerations. It is assumed that an individual compares two employment alternatives — work in the military or work in the private sector — and chooses the one which maximizes economic benefits. This implies that enlistment propensity will increase if there is an increase in the economic benefit of working in the military, e.g., an increase in military pay, or a decline in the economic benefits of working in the private sector, e.g., an increase in unemployment.

The labor supply framework is expanded for analysis of enlistments at the NRD level. We assume that enlistment supply in an NRD depends on the enlistment propensity of the district's residents and on the number who are eligible for enlistment. Propensity and eligibility are influenced by various controllable and exogenous factors which we group into broad categories: economic and demographic factors, recruiting resources, and policies. The economic factors include relative military pay, civilian unemployment, and GI Bill benefits; the demographic factors are the civilian male youth HSDG and HSSR population, racial mix, and urban/rural mix; the recruiting resources are recruiters of each Service; the recruiting policies considered are Air Force and Marine Corps changes in goals and standards.

The number of HSDG contracts in a recruiting district is assumed to be a log-linear function of supply factors:

$$\ln H = a + a_1 LRPAY + a_2 RUNEM + a_3 LAVG + a_4 VEAP + a_5 LBLK + a_6 LURBAN + \ldots + \text{error term.} \quad (1)$$

For each Service H is the number of enlistment contracts for mental group 1-3A HSDG's or mental group 3B HSDG's per population.

B. Definitions of the Explanatory Variables

1. Economic Factors

a. Relative Military Pay

LRPAY = logarithm of regular military compensation over a four year period, divided by full-time equivalent earnings of civilian youths. Military and civilian earnings are discounted at 30 percent. Civilian earnings are aged with data on median weekly earnings of 16-19-year-old males.

Holding other factors fixed, the ratio of military to civilian earnings is expected to have a positive effect on the supply of high school graduates.

b. Civilian Unemployment

RUNEM = change in the unemployment rate for all civilians (cyclical unemployment).

LAVG = logarithm of the average unemployment rate of all civilians in FY 1976-83 (long-run regional unemployment).

We use two unemployment variables. The first is "cyclical unemployment" measured by the difference between the actual unemployment rate of all civilians and the average rate in the district over FY 1976T-83. The second is "long-run regional unemployment" measured by the logarithm of the average unemployment rate over the period FY 1976T-83. We expect increases in both unemployment variables to increase enlistments.

c. Loss of the GI Bill and Army's Ultra VEAP Program

VEAP = dummy variable equal to zero in FY 1976T and one in FY 1977-83 measuring the net effect of the changeover from the GI Bill to the Veterans Education Assistance Program (VEAP).

Educational benefits were substantially reduced in January 1977 with the switch over from the GI Bill to VEAP. We expect that the switch decreased the supply of enlistees. We measure the net effects of the change, using a dummy variable, VEAP.

In FY 1982 Army enlistees in selected MOS's became eligible for expanded GI Bill benefits - "Ultra VEAP." Substantial "kickers", e.g., $15,000, were added to the GI Bill benefits available to Army enlistees. We expect to find that the Ultra VEAP program (The Army College Fund) increased Army enlistment supply in FY 1982-83. The effect of the program is measured with a dummy variable (D82) equal to one in FY 1982-83 and zero in other years.

2. Demographic Factors

a. Population

LHSPOP = logarithm of a district's 17-21-year-old civilian male HSDG and HSSR population (in thousands).

Population is measured using census data on only the number of 17-21-year-old civilians males who are either high school seniors or high school diploma graduates in a Navy recruiting district. We expect that an increase in this population will increase enlistment supply. (Note that LHSPOP does not appear as a separate independent variable. Its effect is derived from the effect of recruiters.)

b. Racial Mix

LBLKPCT = logarithm of the percent of a district's total 17-21-year-old civilian male population that is black.

Blacks, on average, score lower than whites on the entrance tests in the Armed Services Vocational Aptitude Battery (ASVAB). The percent of the total population in a district that is black is used to adjust for this difference. Districts having a higher percentage of blacks are expected to have lower enlistment rates of HSDG's in the upper mental groups and higher enlistment rates of HSDG's in the lower mental groups.

c. Urban/Rural Mix

LURBPCT = logarithm of the percent of a district's total population that resides in an urban area.

Since urban areas have greater population densities, recruiters can make more contacts per hour of work. This should increase recruiter productivity, so, we expect that as urban percent increases there will be increases in enlistments.

3. Recruiters and Policies

a. Recruiters

LNREC = logarithm of Navy production recruiters per population.

LAREC = logarithm of Army production recruiters per population.

LFREC = logarithm of Air Force production recruiters per population.

LMREC = logarithm of Marine Corps production recruiters per population.

We analyze the effects of each Service's recruiters on each Service's enlistment supply. Recruiters provide information on the benefits of enlisting. This induces more individuals to consider a military career and more to actually choose to enlist over civilian alternatives. For this reason we expect a Service's recruiters to increase enlistments.

b. Air Force Policies

In conversation, the Air Force indicated that changes in recruiting policies, e.g., reduction in weight standards, increased supply in FY 1980. To adjust for this change in the eligible population, we include a dummy variable equal to one in FY 1980-83 and zero in other years.

When recruiting was poor in FY 1980, the Air Force reduced standards to increase the eligible population and thereby supply. Later, in February 1982, recruiting improved but Air Force accession requirements were much lower. As a result, the Air Force sharply lowered recruiting goals and changed policies until February 1983. These changes reduced enlistments. To

measure the effects, we include a dummy variable equal to 7/12 in FY 1982, 5/12 in FY 1983, and zero in other years.

Starting in FY 1980, the Marine Corps put a greater emphasis on recruiting HSDG's, i.e., recruiting goals for HSDG's increased relative to those for non-HSDG's. To account for this recruiting policy change, we include a dummy variable equal to one in FY 1980-83 and zero in other years.

C. Functional Form and Interpretation of Coefficients

The log-linear functional form permits diminishing marginal returns with increases in supply factors, such as recruiting resources. It also permits the productivity of recruiters to be affected by the levels of other factors, such as relative military pay. Thus, as relative military pay increases, we expect the productivity of recruiters to increase.

In previous studies we found that a doubling of both recruiters and population implies a doubling (i.e., their elasticities sum to 1.0) of enlistments. However, due to cross-section collinearity — NRD's with more population are assigned more recruiters — the individual effects are difficult to disentangle, and implausible results for population are sometimes obtained. This study attempts to disentangle the effects of recruiters and population by use of better data on population. However, here too collinearity is a problem. As a result, we have used a functional form (Equation 1) which constrains the recruiter and population elasticities to equal 1.0. This formulation yields plausible estimates for population.[3]

The regression coefficients of pay, regional unemployment, recruiters, and black and urban percents are "partial elasticities," i.e., the percentage that total supply changes when a supply factor

3 For results obtained without constraining the effects, see reference no. 1.

increases by one percent and all other factors are held fixed. The partial elasticity of population is given by one minus the elasticity of recruiters.

The coefficient of RUNEM estimates the percentage change in enlistment caused by a one percentage point increase in the unemployment rate. The coefficient of a dummy variable measures the percentage change in enlistment supply caused by existance of the factor for the percentage of the year specified by the variable.

The models are estimated with pooled time-series, cross-section data, using the ordinary least squares procedure.[4]

4 OLS seems to be a satisfactory procedure for estimating this type of model. For evidence, see reference no. 2.

CHAPTER III

RESEARCH FINDINGS

A. The Effects of Supply Factors

Tables 1-4 present the regression results obtained for the two enlistment cohorts under study, using deflated variables (Equation 1). To simplify the discussion, we will focus on the results for 1-3A HSDG's. The determinants of enlistments are quite similar across the Services. Relative military pay, cyclical unemployment, regional unemployment, total high school senior and diploma graduate population, urban mix and recruiters increase enlistments, while black population and the loss of GI Bill benefits cause enlistments to decline.

1. Relative Military Pay

Pay, besides being highly significant statistically, has a very strong effect on enlistment supply. A one-percent increase in relative military pay would cause the supply of 1-3A HSDGs to increase by 2.29 percent for the Army, 0.97 percent for the Navy, 1.79 percent for the Air Force and 0.78 percent for the Marine Corps.

2. Civilian Unemployment

The effect of cyclical unemployment is statistically significant across the Services. The effect of a one-point increase in the unemployment rate is to increase enlistments by 3.5-6.5 percent depending on the Service. These results imply unemployment elasticities of 27-49 percent.[5]

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5 Evaluated at the mean unemployment rate, across districts, of 7.58 percent. (See Table A-2 of Appendix A.)

TABLE 1

ARMY ENLISTMENT SUPPLY PROJECTION MODEL
REGRESSION OUTPUT: EQUATION 1

EXPLANATORY VARIABLES	1-3A HSDG'S	3B HSDG'S
Intercept	1.58	-.68
Logarithm Relative Pay	2.29 (9.13)	3.24 (11.26)
Cyclical Unemployment	.065 (4.64)	.056 (3.47)
Logarithm Regional Unemployment	.13 (1.39)	.27 (2.50)
Loss of G.I.Bill	-.35 (-6.87)	-.29 (-4.87)
Army College Fund	.0019 (.030)	-.19 (-2.50)
Logarithm Recruiters	.93 (7.35)	.70 (4.82)
Logarithm HSSR/HSDG Civilian Male Population**	.070 N.A.	.30 N.A.
Logarithm Percent Black Population	-.10 (-5.35)	.16 (7.26)
Logarithm Percent Urban Population	.017 (.30)	-.20 (-3.13)
R-Square	.66	.64
Mean Square Error	.081	.11
F Ratio	79.78	69.62

* T-values given in parentheses.
** Not estimated directly; calculated as follows: 1 - recruiter elasticity.

TABLE 2

NAVY ENLISTMENT SUPPLY PROJECTION MODEL
REGRESSION OUTPUT: EQUATION 1

EXPLANATORY VARIABLES	1-3A HSDG'S	3B HSDG'S
Intercept	-1.53	-3.07
Logarithm Relative Pay	.97 (4.87)	1.50 (6.86)
Cyclical Unemployment	.034 (3.49)	.029 (2.66)
Logarithm Regional Unemployment	.17 (2.069)	.34 (3.76)
Loss of G.I.Bill	-.28 (-6.57)	-.14 (-3.065)
Logarithm Recruiters	.53 (7.35)	.48 (6.068)
Logarithm HSSR/HSDG Civilian Male Population**	.47 N.A.	.52 N.A.
Logarithm Percent Black Population	-.10 (-6.26)	.053 (2.98)
Logarithm Percent Urban Population	.15 (3.039)	-.012 (-.22)
R-Square	.45	.47
Mean Square Error	.063	.075
F Ratio	37.95	40.39

* T-values given in parentheses.
** Not estimated directly; calculated as follows: 1 - recruiter elasticity.

TABLE 3

AIR FORCE ENLISTMENT SUPPLY PROJECTION MODEL
REGRESSION OUTPUT: EQUATION 1

EXPLANATORY VARIABLES	1-3A HSDG'S	3B HSDG'S
Intercept	-1.10	1.70
Logarithm Relative Pay	1.79 (7.84)	1.50 (5.68)
Cyclical Unemployment	.037 (2.84)	-.020 (-1.32)
Logarithm Regional Unemployment	.20 (2.24)	.17 (1.60)
Loss of G.I.Bill	-.29 (-5.48)	-.11 (-1.86)
Air Force Policy Change 1980-83	.12 (2.84)	.22 (4.53)
Air Force Policy Change 1982-83	-.70 (-6.87)	-.57 (-4.84)
Logarithm Recruiters	.55 (6.17)	.95 (9.20)
Logarithm HSSR/HSDG Civilian Male Population**	.45 N.A.	.050 N.A.
Logarithm Percent Black Population	.12 (-6.74)	.11 (5.05)
Logarithm Percent Urban Population	.14 (2.57)	-.18 (-2.90)
R-Square	.43	.43
Mean Square Error	.073	.099
F Ratio	26.59	26.45

* T-values given in parentheses.
** Not estimated directly; calculated as follows: 1 - recruiter elasticity

TABLE 4

MARINE CORPS ENLISTMENT SUPPLY PROJECTION MODEL
REGRESSION OUTPUT: EQUATION 1

EXPLANATORY VARIABLES	1-3A HSDG'S	3B HSDG'S
Intercept	1.01	-1.93
Logarithm Relative Pay	.78 (3.40)	1.63 (6.67)
Cyclical Unemployment	.061 (4.47)	.047 (3.19)
Logarithm Regional Unemployment	.074 (.73)	.28 (2.55)
Loss of G.I.Bill	-.20 (-3.47)	.0062 (.10)
Marine Corps Policy Change 1980-83	.026 (.55)	.075 (1.49)
Logarithm Recruiters	.93 (6.63)	.70 (4.66)
Logaritmm HSSR/HSDG Civilian Male Population**	.069 N.A.	.30 N.A.
Logarithm Percent Black Population	-.17 (-8.58)	.045 (2.089)
Logarithm Percent Urban Population	.15 (2.58)	.015 (.22)
R-Square	.49	.43
Mean Square Error	.094	.11
F Ratio	37.96	30.13

* T-values given in parentheses.
** Not estimated directly; calculated as follows: 1 - recruiter elasticity.

The effects for regional unemployment are consistent, but much lower (7.2-20.0 percent) and weaker in terms of statistical significance. In previous work, we estimated positive effects for Navy, Air Force, and Marine Corps, but a negative effect for the Army. We suspected that the implausible result for the Army was caused by measurement error. The consistency of the results here supports that hypothesis.

3. <u>The Loss of GI Bill Benefits and Army's Ultra VEAP</u>

The loss of GI Bill benefits in 1977 caused a large decline in enlistment supply, especially for the Army - probably because it offers shorter enlistment terms. The termination of G.I. benefits caused the supply of 1-3A HSDGs to decline annually by 35 percent for the Army, 28 percent for the Navy, 29 percent for the Air Force, and 20 percent for the Marine Corps. However, over this time period (1976-83) there were sharp fluctuations in goals. Changes in goals would be positively correlated to the dummy variable measuring the loss in GI Bill benefits. As a result, we suspect the effect of GI Bill benefits may be overstated by a considerable amount. For the same reason effects of pay and cyclical unemployment may be overstated as well, but we suspect the bias is smaller for these.

The Army's Ultra VEAP program does not seem to have an effect on total enlistments. In Part II of this paper we show that the program appears to channel enlistments into targeted occupations.

4. <u>Population and Recruiters</u>

Recruiters increase enlistments: the elasticities average 0.73, ranging between 53 and 94 percent. The effect of population is positive, but apparently smaller than some people have thought: elasticities average 0.27 but vary substantially from 7 to 47 percent. This suggests that population declines in the 1980s may be less important than some have conjectured.

5. Black Population

As expected, black population has a negative effect on enlistments of 1-3A HSDG's. The elasticity varies only slightly among the Services: -0.10 for Army and Navy; -0.12 for Air Force; and -0.17 for Marine Corps.

6. Urban Population

Enlistment supply is greater in urban areas. A one-percent increase in the urban population variable increases enlistments by 0.2 - 0.16 percent. Apparently recruiter productivity is augmented by population density.

7. Recruiting Policies

Air Force recruiting policies first increased and then decreased supply. The reduction in standards (and other policies) that took effect in FY 1980 increased supply by 12 percent in FY 1980-83. On the other hand, reductions in goals and other policy changes would have reduced Air Force enlistments by 70 percent in FY 1982 and FY 1983, if they had been in force throughout the entire period. Since the policies in question were in effect for only five months in FY 1983, i.e., 42 percent of the year, the effect in FY 1983 is to reduce supply by .42 times .70, or 29.4 percent.

Marine Corps policy changes, the shifting of goals toward HSDG's, appear to have increased supply by only about three percent. The effect is small and not statistically significant. We suspect that this is the result of using an inadequate measure (a constant value dummy variable) to capture the effects of policy and goal changes which occurred over a four-year period (1980-83). We hope to obtain better measures in the future for both Marine Corps and Air Force policy changes.

B. A Forecasting Test

A forecasting test of the Army model was carried out for the FY 1984 time period. Independent variables were projected based on nine months of information, October 1983 - June 1984 (see Table A-2 for national level trends). For details on the forecasting methology see the Goldberg, et.al. paper presented to the Conference of the Southern Economic Association in 1983. See reference no. 2.

In 1984 there were significant declines in unemployment and pay which caused enlistments to decline also. The model forecasted the declines in enlistments fairly accurately. Table 5 compares the forecasts to the actuals in the test period. Enlistments of 1-3A HSDGs actually declined by 17.7 percent; the forecasted decline was 14.9 percent. Forecasts of declines of 3B HSDGs were less accurate (actual of 8.0 versus forecast of 14.1) because this cohort is probably somewhat demand limited.

C. Cost-Effectiveness of GI Bill, Pay and Recruiters

Although the loss of GI Bill benefits in 1977 caused a large decline in enlistment supply, a GI Bill is an expensive way of increasing supply compared with bonuses and recruiters (see Table 6). OSD estimates that a GI Bill similar to the previous one would cost two to three billion dollars per year in steady state over the cost of VEAP. Taking retention effects into account,[6] it would generate about 18,000 additional 1-3A HSDGs for DOD, at a marginal cost that would probably exceed $111,100 per enlistee ($2 billion cost divided by 18,000 enlistees). The cost of using enlistment bonuses would be much less — $13,900 to $39,000.

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6 The GI Bill reduced retention of career military personnel because many left the service to collect GI Bill benefits. Preliminary analysis by OSD indicates the retention losses were about half of the increase in first-term supply.

TABLE 5

FORECASTING TESTS

FORECASTS COMPARED TO ACTUALS IN FY84

	Forecast (F)	Actual (A)	% Error $\left(\frac{F-A}{A}\right)$
1-3A	51,800	52,153	- 0.7
3B	25,200	29,500	-14.6

PERCENT DECLINES RELATIVE TO FY83

1-3A	Actual	17.7
	Forecasted	14.9
3B	Actual	8.0
	Forecasted	14.1

TABLE 6

MARGINAL COST PER 1-3A HSDG IN FY 1979[a]
(In FY 1979 Dollars)

	Army	Navy	Air Force	Marine Corps
GI Bill[b]	111,100 (6,300)[c]	111,100 (5,100)	111,100 (5,100)	111,000 (1,500)
10 Percent Increase In Pay[d]	13,900 (8,200)	39,900 (3,500)	17,200 (6,200)	34,400 (1,200)
10 Percent Increase In Recruiters[e]	4,700 (3,300)	6,000 (1,900)	3,200 (1,900)	5,300 (1,400)

[a] Evaluated at the means of variables in FY 1976T-83 using costs in FY 1979.

[b] Calculated by use of OSD's estimate that a GI Bill would cost $2 billion over the cost of VEAP. Cost per 1-3A HSDG for each Service assumed equal to cost per 1-3A HSDG estimated for DOD as a whole.

[c] Marginal productivities given in parentheses. For GI Bill, estimates are net of retention losses (equal to 50% of the gross effect).

[d] Pay increase of $2,600 given only to NPS male 1-3A HSDGs.

[e] Assumes the marginal cost of fielding a recruiter is $35,000. Assumes increases (10%) in recruiters are as follows: Army, 444; Navy, 325; Air Force, 171; Marine Corps, 211.

However, for moderate expansions of supply, both of these alternatives are compared with recruiters whose costs are $3,200 to $5,30C. Recruiters are less expensive than GI Bill benefits or bonuses because they avoid payments to those who would have joined without special incentive.

D. Conclusions

Part I of this study uses a time-series, cross-sectional approach to estimate enlistment supply models for each Service. The results seem to provide plausible estimates of the effects of supply factors and the capability to accurately forecast Army enlistments. They also yield valuable information on the cost-effectiveness of policies that could be used to affect Army enlistments.

PART II

EXPLORATORY ANALYSIS OF ARMY ENLISTMENTS BY OCCUPATION

CHAPTER I

INTRODUCTION

The study described in this part of the report analyzes Army enlistments in each of the ten DOD one-digit occupational codes. Descriptions of the Military Occupation Specialties (MOS's) within each occupational code are given in Table 7.[7] The methodology for estimating relationships is similar to the one used in the TSCS analysis described in Part I. However, in this study we focus on analyzing the supply of high-quality enlistments at the occupational level, and we include enlistment bonuses as an explanatory factor in an attempt to measure their effect on supply.

Part II is organized as follows: Chapter II specifies the bonus variable used in the regression model; Chapter III reports the estimates of the model; and Chapter IV presents our conclusions. A discussion of the data used to estimate the occupational-level models is found in Appendix B, and Appendix C describes the construction of the bonus variable and alternatives.

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7 For more detail on the Military Occupation Specialties included in each of the ten occupational areas, see reference no. 3.

TABLE 7
DEFINITIONS OF DOD OCCUPATIONAL AREA CODES
1-DIGIT GROUPING

CODE	OCCUPATIONAL AREA	DESCRIPTION
0	**Infantry, Gun Crews, and Seamanship Specialists**	Includes individual weapons specialists and crew-served artillery specialists, armor and amphibious crewmen, and specialists in combat engineering and seamanship.
1	**Electronic Equipment Repairmen**	Includes specialists in the maintenance and repair of various types of electronic and allied equipment, including radio, radar, navigation, weapons, and computers, among others.
2	**Communications and Intelligence Specialists**	Includes the operation and monitoring of radio, radio teletype, radar, sonar and allied communications and intelligence consoles. Also includes the gathering and interpretation of photographic, electronic, and documentary intelligence.
3	**Medical and Dental Specialists**	Includes specialists in patient care and treatment and in technical and related medical and dental services.
4	**Other Technical and Allied Specialists**	Includes specialists in technical and professional-type skills not elsewhere classified. These skills include photography, cartography, meteorology, ordnance disposal, laboratory analysis, and music, among others.
5	**Functional Support and Administration**	Includes general administrative, clerical and personnel specialists. Also includes administrative specialists in data processing, information, and related areas, and functional support specialists in areas such as supply, transporation, and flight operations.
6	**Electrical/Mechanical Equipment Repairmen**	Includes specialists in the maintenance and repair of electrical, mechanical, hydraulic, and pneumatic equipment.
7	**Craftsmen**	Includes the formation, fabrication, and installation of structures and components, the installation and maintenance of utilities, and related trades and crafts.
8	**Service and Supply Handlers**	Includes personnel involved in protective and personal services and non-clerical personnel involved in warehousing, food handling, and motor transportation.
9	**Non-Occupational**	Includes patients and prisoners, students and trainees, and other enlisted and civilian personnel and designators of a non-occupational nature.

CHAPTER II

AN ECONOMETRIC MODEL OF ARMY ENLISTMENT SUPPLY BY OCCUPATION

The supply of Army HSDG enlistment contracts in each of the ten DOD one-digit occ-codes is analyzed using regression analysis. Estimates of regression models are obtained with Navy Recruiting District (NRD) level data for FY 1976-82. Separate models are estimated for mental group 1-3A HSDG's and mental group 3B HSDG's.

Variables included in the occupational-level models are identical to those specified for the models described in Part I of this report. Here, however, we include an additional variable measuring the payoff and coverage of bonus programs, i.e., the "expected" value.[8]

The expected bonus is calculated as follows:

$$(1) \qquad \text{Bonus}(i) = \sum_{j \text{ in } i} \text{BONDOL}(j)/[12 \times \text{TOCC}(i)]$$

where
monthly bonus dollars (BONDOL) are summed over the MOS's in each occ-code by month and divided by the total number of MOS-months in each occ-code (12 x TOCC) to obtain an annual average.[9]

LBONUS_i is the logarithm of BONUS divided by full-time equivalent civilian earnings over a four-year period, discounted at 30 percent, i.e., the logarithm of the relative expected bonus.[10]

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8 For trends in enlistments by occupation, see Appendix B.

9 For the occ-code to MOS mapping used in this study, see Appendix C.

10 The relative expected bonus captures the effects of changes in the magnitude and coverage of bonus programs. It is a "reasonable" measure, but others are possible also. For alternative measures and trends in BONUS and LBONUS see Appendix C.

Holding other factors fixed, we expect $LBONUS_i$ to increase enlistments in an occ-code. Besides a variable for individual occ-codes, we have constructed an aggregate measure for all occ-codes combined, using the same averaging procedure dicussed above. We expect bonuses to increase overall supply as well as enlistments in specific occupation groupings.

Of the ten occ-codes, only six (0, 1, 2, 4, 6, and 8) had bonus programs in FY 76-82 (see Appendix C). $LBONUS_i$ is used as an explanatory variable for these. For occ-codes 3, 5, 7, and 9, we expect to observe negative channeling effects induced by the presence of bonuses in the other occ-codes. In the models for occ-codes 3, 5, 7, and 9, we include the aggregate measure to estimate the extent of these negative cross effects.

CHAPTER III

RESEARCH FINDINGS ON EFFECTS OF SUPPLY FACTORS

Tables 8-11 present the regression results obtained for the 20 Army occupational code models that were estimated. To simplify the discussion, we will focus on the results for 1-3A HSDG's given in Tables 8 and 9. The determinants of enlistments are similar across the occ-codes. With few exceptions, increases in relative military pay, cyclical unemployment, regional unemployment, and recruiters increase enlistments, while black population and the loss of G.I. Bill benefits cause enlistments to decline. The study results on the effects of the other variables are less consistent, and in some cases they are implausible.

A. Civilian Unemployment

The effect of cyclical unemployment is positive in all cases and statistically significant in all but two. The effect of a one-point increase in the unemployment rate is to increase enlistments by 2.5 - 10.0 percent depending on the occ-code. The effect for the total is 7.3, which implies an unemployment elasticity of about 53 percent.[11] The results leave little doubt as to the importance of changes in unemployment over time.

Except for occ-code 0 where the result is not significant, the effects for regional unemployment are positive and usually much smaller than 55 percent, the overall elasticity for cyclical unemployment.

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11 Evaluated at the mean unemployment rate, across districts, of 7.23 percent.)

TABLE 8

MODEL ESTIMATES
NPS MALE 1-3A HSDG ARMY CONTRACTS BY DOD OCCUPATIONAL CODES 0-4

EXPLANATORY VARIABLES	DOD OCCUPATIONAL CODE 0	1	2	3	4
Intercept	.51	-1.39	1.87	-3.65	-3.025
Logarithm Relative Pay	1.66 (5.32)[a]	2.00 (5.43)	2.17 (7.066)	3.61 (10.78)	2.69 (7.12)
Cyclical Unemployment	.061 (3.18)	.070 (3.30)	.077 (4.025)	.096 (4.68)	.065 (2.75)
Logarithm Regional Unemployment	-.025 (-.22)	.084 (.66)	.097 (.85)	.22 (1.76)	.10 (.69)
Loss of G.I.Bill	-.39 (-6.00)	-.14 (-2.26)	-.53 (-4.42)	-.19 (-1.90)	.22 (1.46)
Army College Fund	.22 (2.59)	-.20 (-2.30)	-.12 (-1.49)	-.28 (-3.084)	-.17 (-1.72)
Logarithm Recruiters per Population	.82 (5.12)	.88 (5.20)	1.037 (6.55)	1.12 (6.56)	1.18 (6.068)
Logarithm Percent Black Population	-.075 (-3.12)	-.094 (-3.56)	-.034 (-1.44)	-.085 (-3.32)	-.18 (-6.17)
Logarithm Percent Urban Population	-.11 (-1.54)	.022 (.28)	-.15 (-2.15)	.41 (5.59)	.30 (3.60)
Logarithm of Expected Bonus	.12 (1.87)	.020 (1.35)	.19 (3.53)	-.38[b] (-5.32)	-.23 (-5.23)
R-Square	.59	.42	.59	.62	.48
Mean Square Error	.10	.12	.10	.12	.15
F Ratio	45.17	22.52	44.39	49.75	27.85

[a] T-values given in parentheses.
[b] For these occupational codes no bonuses were offered so we measured the cross effect of bonuses offered in all other occupational codes.

TABLE 9

MODEL ESTIMATES
NPS MALE 1-3A HSDG ARMY CONTRACTS BY DOD OCCUPATIONAL CODES 5-9

EXPLANATORY VARIABLES	DOD OCCUPATIONAL CODE 5	6	7	8	9	TOTAL 0-9
Intercept	-1.12	1.16	.16	-.98	-4.20	1.37
Logarithm Relative Pay	3.071 (8.92)[a]	1.41 (4.10)	.50 (.95)	1.17 (3.30)	2.19 (6.87)	2.14 (8.17)
Cyclical Unemployment	.093 (4.40)	.041 (2.046)	.045 (1.37)	.025 (1.10)	.10 (4.89)	.073 (4.51)
Logarithm Regional Unemployment	.21 (1.66)	.19 (1.55)	1.20 (6.15)	.45 (3.47)	.29 (2.45)	.18 (1.91)
Loss of G.I.Bill	.030 (.29)	-.60 (-6.44)	-.65 (-4.12)	.075 (.27)	.17 (1.80)	-.21 (-2.67)
Army College Fund	.029 (.31)	-.10 (-1.23)	-.38 (-2.61)	.038 (.42)	.41 (4.73)	.067 (.93)
Logarithm Recruiters per Population	1.20 (6.81)	1.072 (6.72)	1.58 (5.85)	1.15 (6.57)	.89 (5.50)	1.019 (7.63)
Logarithm Percent Black Population	.065 (2.46)	-.21 (-8.32)	-.31 (-7.56)	-.24 (-8.65)	-.064 (-2.64)	-.095 (-4.74)
Logarithm Percent Urban Population	-.034 (-.45)	.044 (.60)	-.12 (-.99)	.16 (2.072)	.040 (.57)	.014 (.24)
Logarithm of Expected Bonus	-.32[b] (-4.40)	.063 (3.16)	-.24[b] (-2.12)	-.10 (-2.060)	-.51[b] (-7.64)	-.13 (-2.41)
R-Square	.55	.56	.53	.54	.56	.63
Mean Square Error	.12	.11	.29	.13	.11	.072
F Ratio	37.19	38.49	34.55	36.35	38.54	51.80

[a] T-values given in parentheses.
[b] For this occupational code no bonuses were offered, so we measured the cross effect of bonuses offered in all other occupational codes.

TABLE 10

MODEL ESTIMATES
NPS MALE 3B HSDG ARMY CONTRACTS BY DOD OCCUPATIONAL CODES 0-4

EXPLANATORY VARIABLES	DOD OCCUPATIONAL CODE 0	1	2	3[a]	4[a]
Intercept	-1.44	-7.38	-2.53	7.37E-04	-3.09E-04
Logarithm Relative Pay	3.073 (8.26)[b]	3.56 (6.82)	2.52 (6.43)	8.99E-04 (8.33)	2.68E-04 (6.89)
Cyclical Unemployment	.052 (2.28)	.073 (2.40)	.074 (3.046)	1.39E-05 (2.097)	7.02E-06 (2.89)
Logarithm Regional Unemployment	.18 (1.31)	.21 (1.19)	.024 (.16)	1.18E-07 (.0030)	-1.83E-05 (-1.28)
Loss of G.I.Bill	-.36 (-4.67)	-.067 (-.73)	-.24 (-1.56)	5.12E-05 (1.59)	4.69E-05 (3.018)
Army College Fund	.049 (.48)	-.62 (-5.15)	-.28 (-2.67)	-6.65E-05 (-2.24)	-1.12E-05 (-1.069)
Logarithm Recruiters per Population	.63 (3.30)	.39 (1.61)	.67 (3.31)	2.22E-04 (4.027)	6.75E-05 (3.38)
Logarithm Percent Black Population	.20 (7.079)	.18 (4.73)	.34 (11.34)	4.78E-05 (5.79)	1.38E-05 (4.64)
Logarithm Percent Urban Population	-.36 (-4.37)	.042 (.38)	-.26 (-2.96)	7.48E-05 (3.14)	2.046E-05 (2.38)
Logarithm of Expected Bonus	.091 (1.16)	-.016 (-.76)	.068 (1.018)	-1.09E-04[c] (-4.78)	-1.70E-05 (-3.72)
R-Square	.61	.34	.55	.43	.34
Mean Square Error	.15	.25	.16	1.22	1.59
F Ratio	47.14	15.69	37.90	22.80	16.12

[a] Dependent variable is not logged.
[b] T-values given in parentheses.
[c] For these occupational codes no bonuses were offered, so we measured the cross effect of bonuses offered in all other occupational codes.

TABLE 11

MODEL ESTIMATES
NPS MALE 3B HSDG ARMY CONTRACTS BY DOD OCCUPATIONAL CODES 5-9

EXPLANATORY VARIABLES	DOD OCCUPATIONAL CODE 5	6	7[a]	8	9	TOTAL 0-9
Intercept	-4.389	-.32	1.42E-03	-.46	-6.35	-.72
Logarithm Relative Pay	4.590	2.51	1.79E-04	2.10	2.80	3.14
	(11.02)[b]	(6.89)	(2.010)	(5.81)	(8.18)	(10.27
Cyclical Unemployment	.088	.050	5.88E-06	.009	.064	.063
	(3.44)	(2.37)	(1.074)	(.39)	(3.052)	(3.38)
Logarithm Regional Unemployment	.201	.39	1.19E-04	.52	.46	.30
	(1.32)	(3.067)	(3.65)	(3.94)	(3.69)	(2.69)
Loss of G.I.Bill	.048	-.57	-7.20E-05	-.165	.17	-.12
	(.38)	(-5.76)	(-2.70)	(-.58)	(1.68)	(-1.27
Army College Fund	-.365	-.20	-2.36E-05	-.128	.56	-.060
	(-3.18)	(-2.29)	(-.96)	(-1.38)	(5.91)	(-.71)
Logarithm Recruiters per Population	.851	.92	1.94E-04	1.087	.89	.86
	(4.01)	(5.42)	(4.28)	(6.09)	(5.090)	(5.49)
Logarithm Percent Black Population	.506	.022	-1.048E-05	.027	.15	.19
	(15.88)	(.84)	(-1.54)	(.97)	(5.89)	(7.97)
Logarithm Percent Urban Population	-.116	-.19	-4.85E-05	-.245	-.073	-.20
	(-1.27)	(-2.42)	(-2.47)	(-3.04)	(-.96)	(-2.94)
Logarithm of Expected Bonus	-.272[c]	.056	-2.10E-05[c]	-.036	-.73[c]	-.19
	(-3.09)	(2.64)	(-1.12)	(-.70)	(-10.049)	(2.93)
R-Square	.71	.52	.27	.40	.61	.62
Mean Square Error	.18	.12	8.29	.14	.12	.098
F Ratio	72.35	33.22	11.32	20.74	48.61	50.24

[a] Dependent variable is not logged.
[b] T-values given in parentheses.
[c] For this occupational code no bonuses were offered, so we measured the cross effect of bonuses offered in all other occupational codes.

B. Relative Military Pay and Bonuses

Pay, besides being highly significant statistically, has a very strong effect on enlistments. However, the effect varies considerably among the occ-codes. A one-percent increase in relative military pay would cause the supply to increase by 0.50 to 3.61; the average effect among all occ-codes is 2.14.

The analysis of the effects of bonuses appears to have yielded two interesting findings. First, the bonus variable has the correct sign (positive or negative) in most instances. This suggests that bonuses channel enlistments among occ-codes. Second, the magnitude of the effect of a bonus is much smaller than that of relative pay; this may imply that it is expensive to use bonuses to channel recruits.

Inconsistencies in the findings prevent us from drawing strong conclusions regarding the effects of bonuses. For occ-codes 4, 8, and the total, the signs are negative and unexpected. Table B-2 shows enlistment declines in occ-codes 4 and 8 for 1982 relative to 1976, despite increases overall. Perhaps an important demand factor has been excluded: we suspect that requirements for enlistees in these occ-codes may have been reduced over time, and the omission of this (or some other) factor from the models may be causing the unexpected results we find for occ-codes 4 and 8, and perhaps for the total as well.[12] There are, of course, other possible explanations, e.g., collinearity of bonuses and other variables, small samples, simultaneity problems, etc. However, we believe that an omitted requirements variable is the likely culprit.

In summary, the results suggest 1) channeling effects of bonuses and 2) substantially smaller effects of bonuses than regular pay. However, there are inconsistencies, and these indicate that further research is necessary before findings for the effects of bonuses in individual occ-codes can be viewed confidently.

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12 The results for total are very peculiar. How can bonuses reduce overall enlistment supply?

C. The Loss of G.I. Bill Benefits and the Availability of Army's Ultra VEAP Program

The loss of G.I. Bill benefits in 1977 (VEAP) caused a large (21 percent) decline in overall enlistments. The decline occurred in most occ-codes and was concentrated in 0, 2, 6 and 7. The Army's Ultra VEAP program seems to have a strong positive effect for occ-code 0, but no effect on total enlistments. It is our understanding that the Ultra VEAP program was targetted on selected MOS's, especially those in combat arms. Thus, like bonuses, its primary effect may be to channel enlistees into targeted occupations that are in short supply rather than to increase total enlistments.

D. Population and Recruiters

We find that recruiters increase enlistments: The elasticities are 1.02 for the total, ranging between .82 and 1.58 for the individual occ-codes. The effects of recruiters are consistent, but too large to be believable. They indicate lack of diminishing returns and negative population effects.

E. Black and Urban Population

As expected, black population has a negative effect on high-quality enlistments. An increase in the black population as a percent of the total population causes 1-3A HSDG enlistments to decline by 9.5 percent.

Enlistment supply appears to be greater in urban areas, although the results are mixed. In seven instances the variable is not significant. Of the remaining four, the effect is positive in three occ-codes.

CHAPTER IV

SUMMARY AND CONCLUSIONS

This exploratory study estimates Army enlistment supply equations for each of the ten DOD one-digit occupational codes. Estimates are obtained using regression analysis with annual Navy Recruiting District level data for FY 1976-82. Explanatory variables include the factors in ERL's Enlistment Supply Projection model, e.g., relative military pay, unemployment, recruiters, etc., as well as a measure of the level and coverage of enlistment bonus programs.

Many of the findings are interesting and plausible: military pay, unemployment and recruiters have significant and important effects on total enlistment supply and on enlistments at the occ-code level; bonuses tend to channel enlistees into occupations rather than increase total supply; the effect of bonuses in channeling enlistments is relatively small; like bonuses, the Army College Fund may be channeling enlistees into targeted MOS's. However, some of the results are peculiar. The bonus variable has the wrong sign in three of eleven cases; the effect of recruiters is too large in most instances. Anomolies may be the result of various measurement problems, but we suspect that the most important one is "omitted variables". The most significant omission may be a measure to account for the effect of changes in enlistment goals at the occ-code level. At any rate, because of these anomolies, we have far more confidence in the overall findings than in the specific estimates of parameters.

The study is a limited attempt to analyze the effects of supply factors at the occ-code level. Good progress was made in collecting relevant data on bonuses and in obtaining preliminary estimates of supply models. The results are interesting, but too preliminary at this point to be of much use in evaluating bonus programs or the Army College Fund, or in forecasting enlistments at the occ-code level. Better estimates of the effect of bonuses and other factors are needed in order to have an adequate basis for policymaking and planning.

APPENDICES

APPENDIX A

DATA FOR A TSCS MODEL OF ENLISTMENT SUPPLY IN FY 1976-83

This appendix discusses the Navy Recruiting District data for FY 1976T-83 which were used to estimate the regression models for both of the studies reported in the text. Means and standard deviations of regressions variables are given in Table A-1. Trends at the national level in enlistments and supply factors are given in Table A-2. Below we identify the data sources and explain how the NRD-level data were constructed.

1. High School Diploma Graduate Enlistment Contracts

The Defense Manpower Data Center (DMDC) provided data on enlistment contracts for HSDG's.[13] DMDC renormed the data to reflect the mental group standards implemented in 1981. They used home address Zip Codes to map contracts into Navy Recruiting Districts, and took attrition from the delayed entry pool into account by counting only those contracts that subsequently accessed into the military in the current or following year. For FY 1983, we estimated net contracts from "gross contracts," which include those who will attrite and/or not graduate from high school. (High school seniors were counted as graduates in calculating gross contracts.) Net contracts were estimated to be the product of FY 1983 gross contracts and the FY 1982 ratio of net to gross contracts.

2. Relative Military Pay

Relative military pay is the ratio of the present value (@ 30%) of Regular Military Compensation (RMC) for a typical enlistee over a four-

13 In constructing enlistment variables for the study to update and extend the TSCS model (reported in Part I), GED's and certificate holders (coded as "12-6s" by DMDC) were not included in the counts of HSDG's. In constructing enlistment variables for the exploratory analysis of Army enlistments at the occupational level (reported in Part II), only GED's were excluded in the counts of HSDG's.

TABLE A-1

MEANS AND STANDARD DEVIATIONS OF REGRESSION VARIABLES

Dependent Variables	Mean	Standard Deviation
Logarithm Army 1-3A HSDG	-4.953	.486
Logarithm Army 3B HSDG	-5.620	.534
Logarithm Navy 1-3A HSDG	-4.867	.534
Logarithm Navy 3B HSDG	-5.897	.371
Logarithm Air Force 1-3A HSDG	-4.916	.353
Logarithm Air Force 3B HSDG	-5.965	.409
Logarithm Marine Corps 1-3A HSDG	-5.831	.423
Logarithm Marine Corps 3B HSDG	-6.453	.428

Independent Variables	Mean	Standard Deviation
Logarithm Relative Military Pay - Army	.054	.096
Logarithm Relative Military Pay - Navy	.040	.094
Logarithm Relative Military Pay - Air Force	.051	.100
Logarithm Relative Military Pay - Marine Corps	.049	.097
Cyclical Unemployment	.00041	1.726
Logarithm Regional Unemployment	1.993	.169
Loss of G.I. Bill	.875	.331
Army College Fund	.250	.433
Logarithm Total Civilian Male Youth Population	12.350	.318
Logarithm HSSR/HSDG Civilian Male Youth Population	11.560	.324
Logarithm Urban Population	4.165	.303
Logarithm Black Population	2.173	.907
Logarithm Army Recruiters	-6.946	.152
Logarithm Navy Recruiters	-7.271	.212
Logarithm Air Force Recruiters	-7.888	.190
Logarithm Marine Corps Recruiters	-7.693	.142
Air Force Policy Changes 1980-83	.500	.500
Air Force Policy Changes 1982-83	.136	.243
Marine Corps Policy Changes 1980-83	.500	.500

TABLE A-2

TRENDS IN NPS MALE HSDG 1-3 ENLISTMENTS AND SUPPLY FACTORS

VARIABLE	1976	1977	1978	1979	1980	1981	1982	1983	(estimated 1984
CONTRACTS									
ARMY 1-3A	42,201	32,900	24,069	20,884	24,761	29,880	49,340	60,874	52,153
ARMY 3B	22,187	17,446	13,871	11,821	12,194	14,870	22,744	29,333	29,000
NAVY 1-3A	43,414	38,742	29,196	26,061	34,927	34,405	40,432	44,327	37,493
NAVY 3B	13,637	13,550	10,365	9,840	11,978	12,578	15,314	17,022	17,002
AIR FORCE 1-3A	40,457	36,020	28,703	26,363	37,428	39,359	34,872	35,498	37,233
AIR FORCE 3B	10,522	11,511	10,355	10,877	15,843	15,623	13,616	8,852	9,833
MARINES 1-3A	16,376	13,859	11,643	9,922	13,418	14,902	17,402	19,838	17,738
MARINES 3B	6,954	6,735	6,161	5,715	6,849	7,892	9,929	12,012	12,015
RATIO MILITARY/CIVILIAN PAY									
ARMY	1.06	1.04	1.02	.98	.98	1.05	1.16	1.21	1.18
NAVY	1.05	1.04	1.01	.97	.96	1.01	1.13	1.19	1.16
AIR FORCE	1.04	1.04	1.01	.97	.97	1.05	1.16	1.22	1.19
MARINE CORPS	1.06	1.04	1.02	.97	.97	1.04	1.15	1.21	1.18
RECRUITERS									
ARMY	4,167	4,183	4,061	4,061	4,501	4,701	4,886	4,958	5,032
NAVY	2,863	2,748	3,006	2,863	3,501	3,541	3,336	3,413	3,253
AIR FORCE	1,435	1,652	1,773	1,761	1,905	2,031	1,734	1,419	1,371
MARINE CORPS	2,020	1,953	1,953	1,996	2,244	2,243	2,195	2,261	2,261
G.I. BILL	yes	no	no	no	no	no	no	no	no
ARMY COLLEGE FUND	no	no	no	no	no	no	yes	yes	yes
HSSR/HSDG CIVILIAN MALE POPULATION (in millions)	4.43	4.51	4.57	4.60	4.60	4.58	4.54	4.47	4.33
AVERAGE UNEMPLOYMENT	7.98	7.38	6.22	5.75	6.78	7.42	9.09	10.02	8.02

[a] For all years, Black population = 12 percent and urban population = 67 percent.

year period divided by the present value of full-time equivalent earnings of 18-21 year-old civilian males. Data on military pay and promotion rates were obtained from DOD.

Using 1980 Census microdata, Princeton University Computing Center provided us with calculations of average youth earnings by NRD. The sample was restricted to civilian (non-institutionalized) youth who were working during 1979 for (usually) 35 or more hours per week. Weekly averages were calculated for two groups: 16-19 year-old and 20-24 year-old males. An implicit growth rate of earnings was calculated from these two endpoints, and four year streams were estimated (i.e., for approximately 18, 19, 20, and 21 year-olds) by NRD.

To age the 1979 NRD-level cross section, we used annual national-level data on 16-19 year-old male full-time earnings for 1976-83. Earnings data were obtained from the Bureau of Labor Statistics (Employment and Earnings). The underlying assumption was that growth rates over time are uniform across regions (i.e., NRD's).

3. Unemployment

Monthly unemployment data also are available by county from the Bureau of Labor Statistics. They are estimates of overall (youth and adult) unemployment prepared by state employment service agencies from establishment sources according to BLS procedures. BLS regularly reconciles these figures with Census and CPS estimates. For a detailed description of the differences between establishment and household figures, refer to Employment and Earnings. These county-level data were aggregated to NRD's by the Navy Recruiting Command and provided to us.

The cyclical unemployment variable was calculated as the difference between the annual average rate and an eight-year (1976-83) average for each district.

4. Population

With Census microdata, Princeton University Computing Center provided population counts of 17-21 year-old, civilian, non-institutionalized males by NRD for 1980. Tabulations were made separately for high school seniors and for high school diploma graduates not attending school. This 1980 cross-section snapshot was "aged" backward and forward with growth rates derived from county-level 17-21 year-old male estimates made by Market Statistics Inc. for 1975 and 1983, and from the Census Summary Tape File 3 for 1980. Interpolation across 1975, 1980, and 1983 data points produced the growth rates needed to derive the NRD-level 1976-83 high school senior and diploma graduate population series.

5. Black Population

The percentage of all (i.e., without regard to school status) 17-21 year-old civilian, non-institutionalized males that are black was calculated with 1980 Census microdata at the NRD level. A constant percentage is assumed for the 1976-83 period.

6. Urban Population

The percentage of the population that is "urban" was also tabulated from the 1980 Census microdata for NRD's by Princeton University Computing Center. The following categorizations were tabulated: central city of SMSA; SMSA outside central city; SMSA, central city/remainder not separately identified; mixed SMSA/non SMSA; and outside SMSA. In calculating the "urban" variable, those living outside of SMSA's or in mixed SMSA's were considered as non urban. The urban/non urban split was assumed unchanged over the 1976-83 period.

7. Production Recruiters

NRD-level data on recruiters in FY 1979-82 were provided by DMDC. Aggregate data on recruiters were obtained from the Services for FY 1976T-78. These aggregate data were used to age FY 1979 NRD-level data to yield observations for recruiters in FY 1976T-78. In doing this, we assumed that the distribution of recruiters among NRD's in FY 1976T-78 was the same as that in FY 1979.

APPENDIX B

DATA FOR AN EXPLORATORY ANALYSIS OF ARMY ENLISTMENTS AT THE OCCUPATIONAL LEVEL

This appendix presents descriptions of the database used for the analysis of Army enlistments at the occupational level, reported in Part II of the text. Means and standard deviations of regressions variables are given in Table B-1. Trends by fiscal year for Army enlistments by DOD occupational code are given in Tables B-2 and B-3. For a discussion of the methodology used to construct the bonus variables for this analysis, see Appendix C.

Many of the explanatory variables used in the updating of the TSCS models (reported in Part I of the text) were used in the occupational-level analysis as well. See Appendix A for a discussion of these factors. As noted in Appendix A, for the dependent variables, the Defense Manpower Data Center (DMDC) provided data on enlistment contracts for HSDG's, for the period FY 1976-82.[14] Counts according to DOD occupational area codes were obtained by matching DMDC's enlistment records with their "cohort files." The data were remapped by ERL into the 41 Navy Recruiting Districts existing as of October 1, 1982.

14 In constructing enlistment variables, GED's were not included in the counts of HSDG's.

TABLE B-1

MEANS AND STANDARD DEVIATIONS OF REGRESSION VARIABLES

DEPENDENT VARIABLES	MEANS		STANDARD DEVIATIONS	
Occupational Code	1-3A	3B	1-3A	3B
0	-6.481	-7.003	0.495	0.597
1	-7.709	-9.021	0.456	0.604
2	-6.991	-7.918	0.489	0.597
3	-7.827	0.00018	0.545	0.00014
4	-8.553	0.000065	0.526	0.000048
5	-7.433	-7.915	0.515	0.767
6	-7.136	-7.504	0.491	0.502
7	-9.113	0.00012	0.778	0.00010
8	-7.290	-7.848	0.532	0.474
9	-7.167	-7.878	0.481	0.553
10	-5.012	-5.644	0.432	0.500

INDEPENDENT VARIABLES	MEANS	STANDARD DEVIATIONS
Relative Military Pay	0.036	0.084
Long-run Regional Unemployment	1.993	0.169
Cyclical Unemployment	-0.376	1.389
UVEAP (Army College Fund)	0.143	0.351
VEAP (Loss of G.I. Bill)	0.857	0.351
Black Population	2.173	0.908
Urban Population	4.165	0.304
Army Recruiters	-6.969	0.146
Bonus for Occ-code:		
0	-3.154	0.467
1	-7.366	1.774
2	-3.884	0.881
3	-4.673	0.605
4	-6.017	1.344
5	-4.673	0.605
6	-6.999	1.708
7	-4.673	0.605
8	-5.206	1.992
9	-4.673	0.605
10	-4.673	0.605

TABLE B-2

ARMY ENLISTMENTS BY OCCUPATION AND FISCAL YEAR
for
1-3A HSDG's

DOD OCCUPATION CODE	1976	1977	1978	1979	1980	1981	1982
0	9170	6227	5173	5020	5907	8093	14576
1	2573	2456	1670	1559	1812	2235	3093
2	4996	4043	2900	2691	4228	5273	7826
3	3662	2496	1426	1290	1519	1831	2311
4	1507	1160	824	745	783	826	1075
5	3934	3262	2762	1546	2171	2712	4549
6	5296	4364	3258	2801	3004	3774	5820
7	1367	675	434	603	671	517	473
8	5195	3728	2870	2744	2523	3515	4944
9	5228	4765	3009	2222	3076	2843	6218
10	42909	33176	24295	21220	25693	31618	50885

TABLE B-3

ARMY ENLISTMENTS BY OCCUPATION AND FISCAL YEAR
for
3B HSDG's

DOD OCCUPATION CODE	1976	1977	1978	1979	1980	1981	1982
0	5888	3759	3422	3291	3167	4845	8197
1	784	685	564	478	530	594	656
2	2279	1668	1435	1291	1780	1926	2544
3	1156	934	620	645	646	627	804
4	335	319	224	218	253	247	359
5	2962	2337	2009	1165	1309	2116	2579
6	3777	2949	2212	1792	1906	2565	3938
7	933	503	350	473	530	459	534
8	2560	1901	1611	1554	1485	2008	2540
9	3195	2491	1578	1204	1368	1162	2828
10	23871	17547	14039	12113	12974	16549	24979

APPENDIX C

CREATION OF BONUS VARIABLE DATA BASE

Several variables were created to measure bonus availability and financial incentive for each of nine DOD Occupational Codes (occ-codes). We utilized monthly information by the Military Occupation Specialities (MOS's) within each occ-code, spanning the June 1972 to March 1984 period, to build an annual FY 1976-83 bonus variable data base.

As a first step we identified those MOS's for which enlistment bonuses were offered to E-3s; reserve force MOS's were excluded. The bonus-eligible MOS's comprising each occ-code are shown in Table C-1. During the period covered, there were no bonus-eligible MOS's in occ-codes 3, 7, or 9 (and 5 was virtually empty).

Next, we counted the number of "bonus months" (BONMON) by fiscal year for each occ-code. A bonus month is the offer of a bonus for one month in a particular MOS. The ratio of bonus months to the total number of potentially available "MOS months" (defined as 12 times the number of MOS's in the occ-code) is one measure of bonus coverage in an occ-code. Table C-2, presents coverage calculated in this way. As can be seen, coverage is comparatively high in occ-codes 0 and 2; growth over the period was particularly dramatic in occ-codes 2 and 4.

Bonus-month-dollars (BONDOL) is the value of the offer. The BONMON and BONDOL variables are building blocks for constructing regression variables. From these building blocks, the following variables were defined and calculated:

(1) PAYOFF = BONDOL/BONMON

PAYOFF is the average dollar value of the bonus among bonus-eligible MOS's in an occ-code. For example, in 1980 for occ-code 0 the

TABLE C-1

BONUS ELIGIBLE MOS's
(October 1975 to September 1983)*

DOD OCCUPATIONAL CODE	MOS MEMBERS
0	11B, 11C, 11D/E, 11F, 11H, 11M, 11X, 12B, 12E, 12F 13B, 13M, 15D, 15E, 15J 16B, 16C, 16D, 16E, 16L, 16P, 16R, 16S, 16T, 16X 19A1/2/3/4 54C
1	21G, 21L, 22L, 24G, 24H, 24L, 24M, 26B, 26D, 27D, 27E, 27G, 27H 31S, 31T, 32D, 35E, 35F
2	05B, 05B(SF), 05C, 05D, 05G, 05H, 05K 13C, 13E, 13F, 13R, 16H/J, 17B, 17C, 17K, 19D 31K, 31M 72E 93H, 93J, 96C 98C1, 98Cw/lang., 98GO-AE, 98GV-VN, 98G2 PL, 98G3-LA, 98G4-GM, 98G5-AP, 98G6-KP, 98G7-CM, 98G8-CX, 98G9-RV, 98GL-AA, 98GL-AZ, 98GL-DG, 98GL-AN, 98GL-BN, 98GL-BY, 98GL-CA, 98GL-FR, 98GL-KV, 98GL-PF, 98GL-PT, 98GL-SW, 98GL-TV, 98GL-PQ, 98J
3	NONE
4	54E, 55D, 82B, 82C, 82D, 93E
5	76C, 76P, 76V
6	36C, 36D, 36H 45D, 45K, 45L, 45N, 45P, 45R, 46N 52D, 52F, 55B, 55G 63B, 63D, 63E, 63G, 63H, 63J, 63N, 63S, 63T, 63W, 63Y
7	NONE
8	43E, 64C, 76W, 94B
9	NONE

* MOS's for which enlistment bonuses were offerred for part or all of the period.

TABLE C-2

BONUS MONTHS AND COVERAGE BY OCCUPATIONAL CODE
(FY 1976-83)

DOD OCCUPATIONAL CODE	1976	1977	1978	1979	1980	1981	1982	1983
	BONUS MONTHS							
0	104	103	118	138	159	189	226	204
1	9	24	13	0	0	14	24	24
2	29	94	123	171	206	284	325	353
3	0	0	0	0	0	0	0	0
4	1	10	12	12	23	43	53	54
5	0	0	0	0	0	0	0	2
6	0	23	47	2	3	18	36	52
7	0	0	0	0	0	0	0	0
8	0	7	20	24	21	12	12	19
9	0	0	0	0	0	0	0	0
	COVERAGE* (percent)							
0	31	31	35	41	47	56	67	61
1	1	3	2	0	0	2	3	3
2	4	14	18	25	30	41	47	51
3	0	0	0	0	0	0	0	0
4	0	2	3	3	5	10	13	13
5	0	0	0	0	0	0	0	0
6	0	4	8	0	0	3	6	8
7	0	0	0	0	0	0	0	0
8	0	6	19	22	19	11	11	18
9	0	0	0	0	0	0	0	0

* Coverage is the ratio of bonus months to (total) MOS months in each occ-code. Total MOS months equal 12 times the number of MOS's in the occ-code: 0: 336; 1: 696; 2: 696; 4: 420; 5: 324; 6: 612; 8: 108.

payoff was \$2,305 (see Table C-3).

(2) $$\text{EXPTD} = \text{BONDOL}/(12 \times \text{TOCC})$$

EXPTD is the expected dollar bonus among all MOS's (including ineligible MOS's) in an occ-code; note that 12 times TOCC is the count of total MOS months in the occ-code. EXPTD also can be viewed as the product of coverage and payoff. For occ-code 0 in 1980, EXPTD is \$1,090 — almost half the PAYOFF value, indicating a "live" situation in about half the MOS's (i.e., about 50 percent coverage).

Trends in the payoff and expected bonus amounts are reported in Table C-3 by occ-code. Payoff amounts are somewhat higher in occ-codes 0 and 2. Expected bonuses, as the product of payoff and coverage, are larger in occ-codes 0 and 2, primarily because of the greater coverage.

We also defined (and calculated) variables for each occ-code relative to all the other groups in a given year.

E measures dollar "coverage" for the j^{th} occ-code:

(3) $$E(j) = \text{BONDOL}(j)/\sum_k \text{BONDOL}(k), \text{ and } k \neq j$$

F measures payoff in the j^{th} occ-code:

(4) $$F(j) = \text{PAYOFF}(j)/[\sum_k \text{BONDOL}(k)/\sum_k \text{BONMON}(k)], \text{ and } k \neq j.$$

In the regression analyses, payoff and expected bonus are deflated by civilian earnings. For those occ-codes without bonus-eligible MOS's (3, 7, 9, and 5) we defined average coverage, payoff, and expected bonus variables across the other occ-codes and tested for (negative) cross effects.

TABLE C-3

PAYOFF AND EXPECTED BONUS BY OCCUPATIONAL CODE
(FY 1976-83)

DOD OCCUPATIONAL CODE	PAYOFF							
	1976	1977	1978	1979	1980	1981	1982	1983
0	1885	1888	2000	1996	2305	3264	3630	4000
1	1611	1917	1500	0	0	2036	2750	2750
2	1741	2372	1939	2187	2461	2926	3313	3294
3	0	0	0	0	0	0	0	0
4	1500	1500	1500	1500	1630	2453	2839	2444
5	0	0	0	0	0	0	0	2500
6	0	1500	1500	1500	1500	2000	2402	2346
7	0	0	0	0	0	0	0	0
8	0	1500	1900	2000	2071	2500	2916	3447
9	0	0	0	0	0	0	0	0

EXPECTED BONUS

0	583	578	702	819	1090	1836	2441	2428
1	20	66	28	0	0	40	94	94
2	72	320	342	537	728	1193	1542	1670
3	0	0	0	0	0	0	0	0
4	3	35	42	42	89	251	358	314
5	0	0	0	0	0	0	0	15
6	0	56	115	4	7	58	141	199
7	0	0	0	0	0	0	0	0
8	0	97	351	444	402	277	324	606
9	0	0	0	0	0	0	0	0

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